INTERIM GUIDANCE FOR SAMPLING AGRICULTURAL FIELDS THAT ARE PROPOSED FOR SCHOOL SITES

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The Situation: Agricultural properties represent a unique class of sites. They tend to be large in acres and have a well-defined group of potential contaminants resulting from the uniform application of agricultural chemicals across the site. Experience has shown that unless the site history indicates otherwise, analysis can be limited to organochlorine pesticides and heavy elemental metals such as arsenic and lead. To establish a uniform approach for evaluating these sites, guidance for sampling and analysis has been developed.

Identifying an Agricultural Site: Agricultural sites include those that are under cultivation with row, fiber or food crops, orchards, or pastures, where agricultural chemicals were applied uniformly consistent with normal application practices. Fallowed and former agricultural land that has not been disturbed beyond normal disking and plowing practices are also included. Pesticide mixing/loading areas, residences, barns, animal facilities, ditches and other areas that may have been treated differently from an agricultural field are not considered agricultural sites for this guidance. Similarly, an urban area that was agricultural land in the past does not qualify as agricultural since development of the land would have resulted in the disturbance and redistribution of potential agricultural contaminants in the soil.

Sample Collection for Agricultural Sites: The number of samples required to characterize the site is dependent on the site size as shown in the table below.

Land Size	Suggested Minimum Sampling Locations
One (1) to two (2) acres	Discrete samples taken on ¼ acre centers
Greater than two (2) up to four (4) acres	Discrete samples taken from eight (8) locations evenly spaced across the site
Greater than four (4) up to twenty (20) acres	Eight (8) composite samples from discrete samples taken on half-acre centers.
Twenty-one (21) to sixty (60) acres	Fifteen (15) composite samples from discrete samples taken on one (1) acre centers.
Sixty-one (61) to one hundred (100) acres	Twenty five (25) composite samples from discrete samples taken on one (1) acre centers
Greater than one hundred (100) acres	Consult with DTSC

Analysis of Agricultural Samples: All samples must be analyzed for organochlorine pesticides, arsenic, and lead. Four on-site samples and four background samples must be analyzed for CAM 17 metals. If the history of pesticide application, or the history of crops grown indicates the use of persistent pesticides such as paraquat, then these chemicals must also be evaluated in each of the samples.

Interpretation of Data: All detected pesticides, and any on-site metals above background must be evaluated in a risk assessment as described in the DTSC Preliminary Endangerment Assessment Guidance Manual. If the maximum detected concentrations on-site pose an unacceptable risk or hazard, a spatial analysis should be conducted to determine if the elevated levels represent a “hot spot”, or are representative of concentrations across the site. When there is an indication of one or more “hot spots”, risk or concentration isopleths should be constructed to differentiate between those areas of the site in need of further action and those where no further action is required.

Summary of Results:

As shown in the table below, a total of 354 agricultural sites have been considered for potential use as a school site. These are sites that have or are being used for the production of crops, and do not include farm buildings, pesticide mixing/loading areas, or former agricultural land that has been disturbed beyond normal disking and plowing practices. The sites have been located across the State with the majority in the Sacramento-San Juaquin Valley, Oxnard Plains, and Imperial Valley. Of the 354 sites evaluated, three required remediation or soil clean up to reduce the risk from contaminants to levels acceptable to school children and staff.

Ag Site Data	
Total Ag Sites	354
Number COCs identified	25
Number of sites remediated	3

The next figure provides data from 10 selected sites across the State. As can be seen, DDT and it's derivative DDE where by far the most frequently detected pesticides. Interestingly, the concentrations they were detected at were well below the concentrations posing unacceptable level of risk or hazard. Toxaphene, dieldrin, and chlordane, although detected less frequently than DDT and DDE, were occasionally detected at elevated concentrations that posed an unacceptable risk or hazard to future students and staff. Although not shown on the table below, on-site metals including arsenic and lead have rarely been detected above background levels.

Selected Ag Site Soil Pesticide Data			
Pesticide	**Sites Detected**	**Concentration Range (ug/kg)**	**Acceptable Concentration**
DDE	78	5 - 1540	1700
DDT	70	1 - 1570	1700
DDD	36	2 - 419	2400
Toxaphene	**23**	**10 - 5970**	**400**
Dieldrin	**22**	**4 - 31**	**30**
Chlordane	**16**	**47 - 2100**	**1600**
Endrin	10	1 - 2	18000
Heptachlor	4	1 - 2	110
Aldrin	3	5 - 16	29
Heptachlor Epoxide	3	1 - 2	53
Paraquat	2	10 - 2100	270000

Conclusions:

- **residual levels of DDT and its derivatives are commonly found in California agricultural soils at very low concentrations that do not pose an unacceptable risk or hazard to future residents, students, and staff;**
- **the organochlorine pesticides toxaphene, dieldrin, and chlordane have been the major pesticides driving unacceptable levels of risk requiring remediation by soil removal;**
- **on-site metals, including arsenic and lead, have rarely been detected above background concentrations;**
- **the vast majority of agricultural sites that have been used for crop production do not contain residual concentrations of pesticides or metals that would pose an unacceptable risk or hazard to future students and staff.**

Abstract
Metals are naturally occurring in soil, and as such, can prove problematic when identifying chemicals of potential concern (COPC) for risk assessment purposes. Arsenic is one of the more contentious metals because the concentration at which it poses an unacceptable risk is often well below background and ambient levels typically encountered. HERD used the combined arsenic data from 19 sites (1097 individual sample locations) to establish a regional, ambient arsenic range for the Los Angeles area. The upper limit of the arsenic ambient range, 11.3 mg/kg, was defined as the 95% Upper Confidence Limit of the 99th Percentile Concentration ($UL_{0.95(X_{0.99})}$). The following summarizes the combined arsenic data set and presents the statistical methodology used to derive this upper-bound, ambient arsenic concentration.

Data Evaluation
A total of 19 sites, distributed throughout the greater Los Angeles area, were included for this analysis. The data from the 19 sites were combined into a single data set of 1097 samples. Individual sample concentration ranged from non-detect (0.75 mg/kg or less) to 177 mg/kg. Figure 1 presents a plot of the frequency verses arsenic concentration, also known as a histogram. The shape of the histogram clearly demonstrates a classical, lognormal distribution.

The data were analyzed for values that do not conform to the pattern established by the majority of values in the data set, e.g., ***outliers***. To determine the outliers in the arsenic data set, a pictorial summary called the box plot was utilized. The Box Plot (Figure 2) indicates that the nine largest and two lowest values are outliers (e.g., 177, 61.4, 49.2, 31.0, 27.6, 26.5, 24.0, 23.3, 22.7, 0.067 and 0.0173 mg/kg).

Statistical Methodology
As shown in Figure 3, the log-transformed arsenic data is normally distributed (i.e., the arsenic data fits a lognormal distribution), thereby making it possible to use an estimate of an upper percentile of ambient arsenic concentrations as the value to be compared with the maximum reported site concentration of arsenic (C_{max}).

For this analysis, the 95% Upper Confidence Limit on the 99th Percentile was chosen as the upper limit concentration. The upper limit of the data set can be estimated according to the following equation:

$$UL_{1-\alpha}(x_p) = \bar{x} + sK_{1-\alpha,p}$$

Where,

$UL_{1-\alpha}(x_p) = The\ Upper\ Limit\ of\ the\ data\ set$

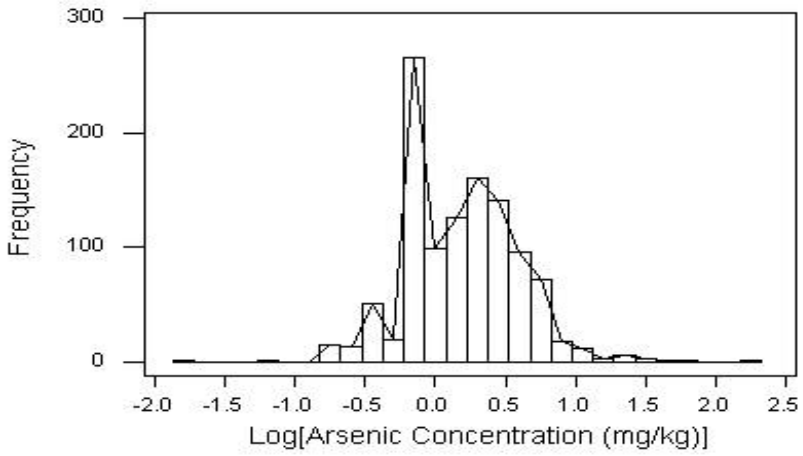
$\bar{x} = Mean\ \ of\ the\ data\ set$

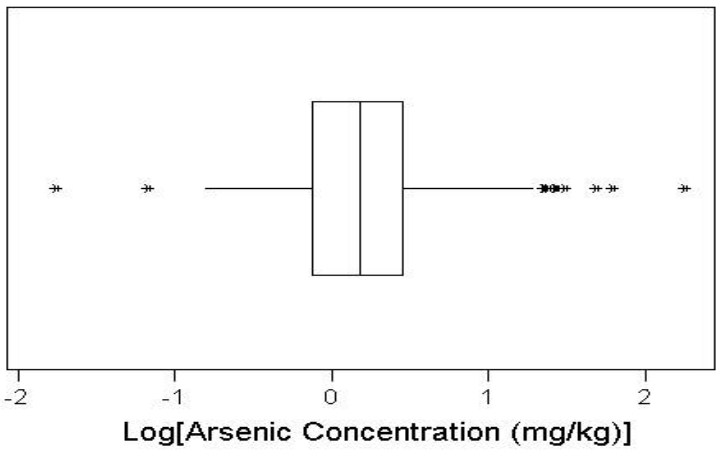
$s = Std.\ Dev.\ of\ the\ mean$

$K_{1-\alpha,p} = Statistical\ tolerance\ \ factor\ \ for\ estimating\ an\ Upper\ 100(1-\alpha)$
$Confidence\ Limit\ on\ the\ \ pth\ Quantile$

The Upper Limit Concentration, $UL_{0.95(X_{0.99})}$, for ambient arsenic in the Los Angeles Area is
11.32 mg/kg

Conclusions
Based on the data analyzed, the 95% Upper Confidence Limit of the 99th Percentile Concentration ($C_{UL0.95(X0.99)}$) for arsenic in the LAUSD is 11.3 mg/kg. This concentration can be used to determine if the onsite C_{MAX} is less than or equal to $C_{UL0.95(X0.99)}$. If all the onsite samples are less than the $C_{UL0.95(X0.99)}$, then arsenic can be eliminated as a COPC at the site. If some onsite samples are greater than the $C_{UL0.95(X0.99)}$, then these samples should be further evaluated in consultation with technical staff from the Department of Toxic Substances Control.





Normal Probability Plot for Log[Arsenic Data Without Outliers]